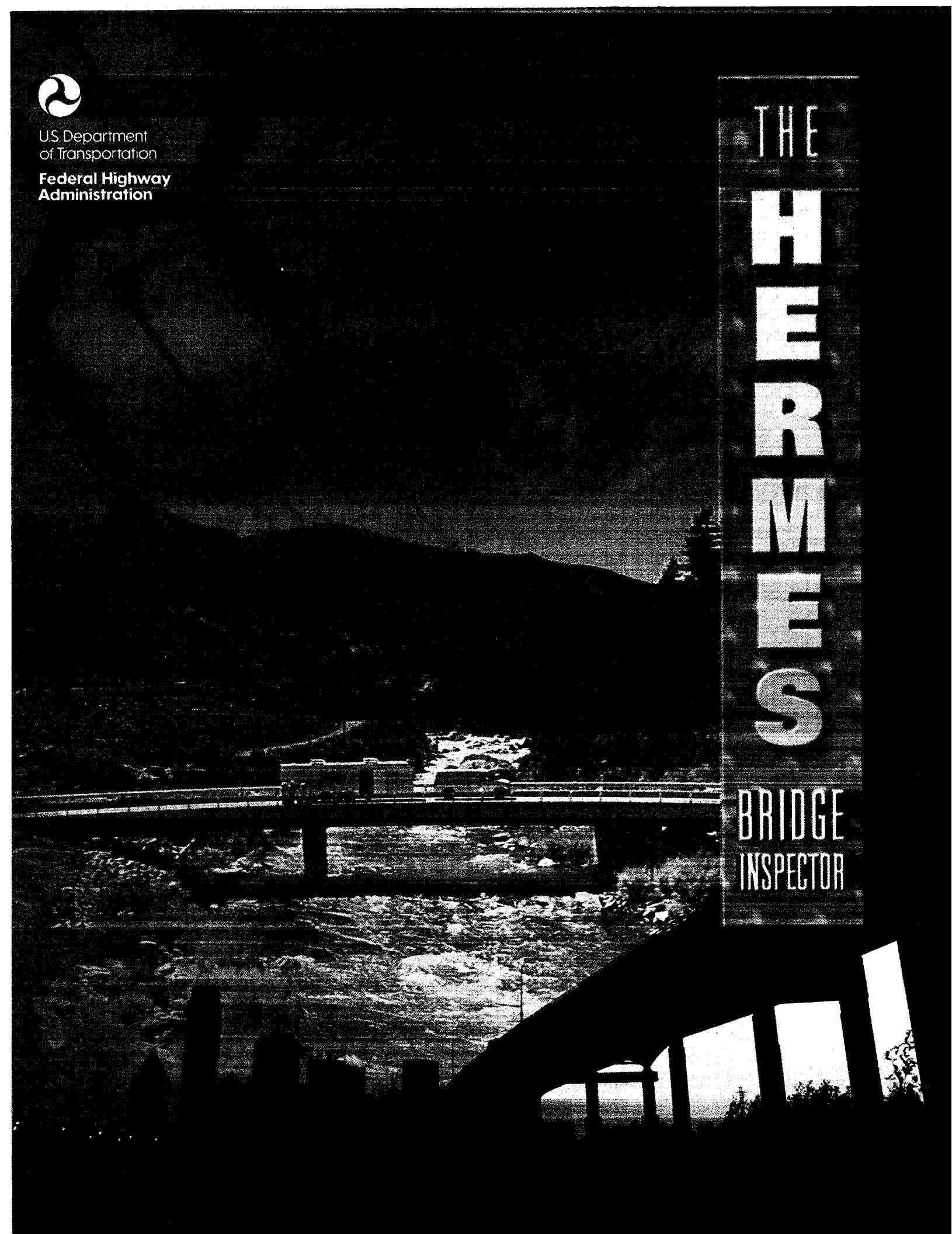




U.S. Department
of Transportation

Federal Highway
Administration



THE
HERMES

BRIDGE
INSPECTOR



THE PROBLEM

The National Bridge Inventory indicates that there are more than 300 million m² (3.2 billion square ft²) of bridge deck in the United States. The service life of a deck can be much shorter than the substructure and super-

THE GOALS OF THE HERMES PROJECT ARE TO DEVELOP A SYSTEM THAT CAN:

- RELIABLY DETECT, QUANTIFY, AND IMAGE DELAMINATIONS IN HIGHWAY BRIDGE DECKS.
- OPERATE AT NORMAL HIGHWAY SPEEDS, ELIMINATING THE NEED FOR LANE CLOSURES.
- INSPECT A LARGE NETWORK OF BRIDGES QUICKLY AND EFFECTIVELY.

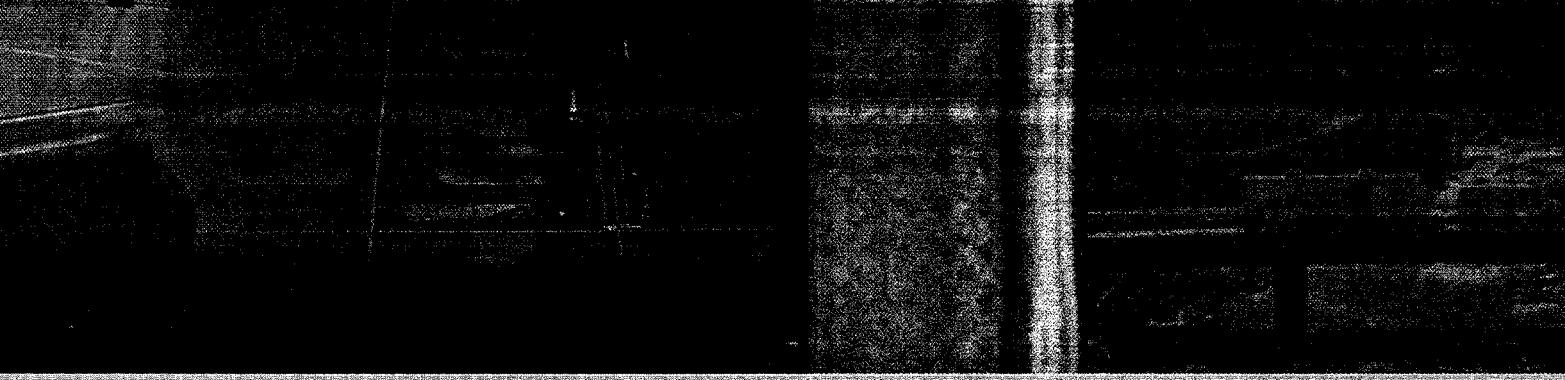
structure of a bridge, and the Federal Highway Administration (FHWA) alone is currently investing an estimated \$1 billion annually for deck rehabilitation. Bridge decks may deteriorate due to corrosion of reinforcing steel, resulting in delaminations and spalling that can make a deck structurally deficient. The ability to detect these defects is critical in directing repairs to the most at-risk bridges and will help optimize the use of limited funds. Cost overruns on rehabilitation projects can also be reduced if accurate condition assessment tools are available.

CURRENT INSPECTION METHODS

Currently available methods for evaluating bridge decks include visually inspecting the deck, sounding a bare deck with a chain or hammer, measuring the half-cell potential of the deck, and taking cores. All of these methods may require lane closures and have limited ability to determine the internal condition of the deck over the entire deck area. In addition, these methods are not effective for accurately determining the exact location and extent of delaminations in a bridge deck and are difficult to apply rapidly to a large number of bridges. More advanced techniques, such as thermographic imaging and existing ground-penetrating radar (GPR) systems, have not satisfied the need for reliable, quantitative, and efficient bridge deck inspection technology.

THE HERMES APPROACH

HERMES is an innovative ground-penetrating radar system that uses a unique array of impulse radar modules to create images of internal defects in concrete bridge decks. HERMES is designed to launch high-frequency electromagnetic pulses into a bridge deck while the system travels at normal highway speeds, evaluating the bridge deck without the need for lane closures. The system is comprised of a computer workstation and data storage device, a survey wheel, control electronics, and an array of 64 antenna modules or transceivers.



The most unique design feature of HERMES is the antenna array that consists of air-coupled ultra-wideband horn antennas producing signals with a frequency content ranging from 0.5 to 5 GHz. The arrangement of the transceivers gives samples across a 2-m width of the deck at 3-cm intervals. In the direction of movement, 3-cm spacing or less is attainable. The density of data enables synthetic aperture radar techniques to be used in the processing of the data, and three-dimensional images can be produced.

The system, developed at the Lawrence Livermore National Laboratories, offers significant improvements over traditional GPR systems because of its unique antenna array and the sophisticated data processing used to create two- and three-dimensional images.

POTENTIAL HERMES ADVANTAGES

The advantages of the HERMES radar system include:

- ▶ Quantitative mapping of deck delaminations.
- ▶ Penetration through asphalt layers.
- ▶ Fast data acquisition at normal highway speeds.
- ▶ Two- and three-dimensional imaging of the internal structure and defects in a deck.

FIELD TESTING OF THE HERMES PROTOTYPE

The goals of the HERMES field tests are to:

- ▶ Evaluate the functionality of the prototype system under actual field conditions.
- ▶ Develop advanced signal processing algorithms to aid in the processing of data.
- ▶ Define the requirements for a second-generation system.

By providing a thorough and systematic evaluation of the prototype system, FHWA is laying the groundwork for the development of a second-generation HERMES system.

The unique capabilities and expertise of the Nondestructive Evaluation (NDE) Validation Center are brought to bear on this important project to ensure that Phase Two of this research is focused on providing an effective system for the inspection of bridge decks. The potential advantages that can be realized with the successful development of HERMES II are:

- ▶ Quantitative and reliable condition assessment of bridge decks.
- ▶ The ability to assess a large network of bridges quickly.
- ▶ Presentation of deck condition data in a format that can easily be converted to engineering plans and can provide accurate estimates for deck rehabilitation.

HERMES Bridge Inspect

FHWA NDE VALIDATION CENTER

The FHWA NDE Validation Center is a national resource dedicated to the development and testing of NDE technologies for inspection of the highway infrastructure. Located at the Turner-Fairbank Highway Research Center in McLean, VA, the center is comprised of a laboratory facility, test bridges for field evaluation of technology, and bridge component specimens that contain various forms of deterioration. The technical staff at the center is involved in the development of a broad range of NDE technologies, including electromagnetics, ultrasonics, wireless technology, radiography, and NDE reliability. The center is designed to be a technical resource for State transportation agencies, industry, and academia. For more information on the NDE Validation Center, please visit our Web site at www.tfhrc.gov, or contact:

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JOIN THE HERMES TEAM

The State of California is leading the effort to develop a second-generation HERMES system that incorporates the improvements and developments resulting from the testing and evaluation of the prototype system. The HERMES II project will begin in the year 2000, with the goal of delivering this revolutionary technology within 3 years. For more information on joining this effort, please contact the FHWA NDE Validation Center.



NDE Validation Center

Federal Highway Administration

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